

Appl. No. 10/820,856
Amendment dated: August 13, 2007
Reply to OA of: May 15, 2007

REMARKS

This is in response to the Official Action of May 15, 2007 in connection with the above-identified application. Applicants have amended the claims of the instant application in order to more precisely define the scope of the present invention, taking into consideration the outstanding Official Action.

Specifically, Applicants have amended claim 1 to recite that the copper and tin of the second barrier layer are not fully reacted to each other. Support for this amendment may be found at, e.g., paragraph [0020] of the specification as originally filed. Applicants have also added new claim 20, which recites that the tin and copper of the second barrier layer are present in the second barrier layer at the time of disposing the second barrier layer on the wetting layer, and new claim 21, which recites a solder bump disposed on the second barrier layer, wherein the solder bump comprises tin and the tin of the second barrier layer is not from the tin of the solder bump. Support for these amendments may be found throughout the specification as originally filed, including, e.g., paragraphs [0019] and [0020].

Applicants respectfully submit that all claims now pending in the instant application are in full compliance with the requirements of 35 U.S.C. §112 and, in light of the amendments to the claims described above, are patentable over the references of record.

The rejection of claims 1 and 4 under 35 U.S.C. §102(b) as being anticipated by Mis et al. (US Pat. No. 5,767,010) has been carefully considered but is most respectfully traversed in light of the following comments.

Applicants wish to direct the Examiner's attention to MPEP § 2131 which states that to anticipate a claim, the reference must teach every element of the claim.

"A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). "The identical invention must be shown in as complete detail as is contained in the ... claim." *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed Cir.

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1989). The elements must be arranged as required by the claim, but this is not an *ipsissimis verbis* test, i.e., identity of terminology is not required. *In re Bond*, 910 F.2d 831, 15 USPQ2d 1566 (Fed.Cir. 1990).

The Official Action urges that Mis discloses every element of claim 1, including an under bump metallization structure comprising an adhesive layer 28, a first barrier layer 30, a wetting layer 32 and a second barrier layer 34' wherein the second barrier layer comprises tin and copper and wherein the quantity of the copper is larger than that of tin. The Official Action expressly acknowledges that the tin and copper is present in the second barrier layer 34' in the form of the compound Cu_3Sn .

Applicants respectfully traverse the §102 rejection in light of the amendments to claim 1 discussed above. Specifically, Applicants respectfully submit that the Mis reference fails to disclose the invention recited in claim 1 because the Mis reference fails to disclose a second barrier layer wherein the tin and copper of the second barrier layer are not fully reacted.

As disclosed at, e.g., col. 4, lines 11-27 of the Mis reference, a microelectronic device 20 includes an under bump metallurgy layer 34 comprised of a chromium layer 30, a phased layer 32 of chromium and copper and a copper layer 34. Layer 34 is clearly made of only copper and therefore does disclose a second barrier layer comprising copper and tin as recited in claim 1. Accordingly, Applicants respectfully submit that this portion of Mis clearly fails to disclose the invention recited in claim 1.

The Mis reference continues on to describe how solder bumps 42 are reflowed, causing an intermetallic layer 34' to form. More specifically, Mis discloses at, e.g., col. 5, lines 58-67, that the reflowing of the solder bumps 42 causes the copper layer 34 to react with the lead-tin solder balls 42 to form an intermetallic layer 34' comprising Cu_3Sn . The reaction of copper in the layer 34 and the tin in the solder balls 42 forms a chemical compound of reacted copper and tin in the form of Cu_3Sn . Accordingly, Mis makes it abundantly clear that the presence of copper and tin in the alleged second barrier layer 34' is only in the form of reacted tin and copper, i.e., Cu_3Sn . There is no tin in the intermetallic layer 34' that is not reacted to copper.

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To the contrary, the present invention is clearly directed to a structure comprising a second barrier layer, wherein the second barrier layer comprises copper and tin that are not fully reacted to each other. The second barrier layer is an alloy (see, e.g., paragraph [0019] of the originally filed application) and therefore copper and tin in the alloy are unreacted and free to react with other elements that may diffuse into the layer.

The significance of the copper and tin in the second barrier layer being unreacted may be clearly seen by reading, e.g., paragraph [0020] of the specification of the instant application. Paragraph [0020] explains that when the tin solder ball is placed on the second barrier layer and reflowed, the tin of the solder ball will migrate down into the under bump metallization layers balls. By providing a second barrier layer with an abundance of unreacted copper, the majority of the tin diffusing into the second barrier layer will react with the copper of the second barrier layer. Only minor amounts of tin will remain to continue down to the wetting layer and first barrier layer, thus meaning that very few discontinuous blocks of, e.g., Ni_3Sn_4 will be created at the interface of the first barrier layer and the adhesive layer. Preventing the formation of discontinuous blocks at the first barrier/adhesive layer interface will enhance the bonding strength of the bumps to the UBM layer and prevent bumps from peeling off the UBM layer.

Thus, because Mis only discloses reacted tin and copper in the alleged second barrier layer (i.e., Cu_3Sn) while Applicants claim a second barrier layer of unreacted copper and tin, Applicants respectfully submit that Mis fails to disclose every element of amended claim 1. Consequently, the Mis reference is incapable of properly supporting a §102 rejection according to the guidelines set forth in MPEP §2131 and the §102 rejection of claims 1 and 4 over Mis should therefore be withdrawn.

The rejection of claim 3 under 35 U.S.C. §103(a) as being unpatentable over Mis as applied to claim 1 in view of Michael (US Pat. No. 5,563,102) and the rejection of claim 7 under 35 U.S.C. §103(a) as being unpatentable over Mis have each been carefully considered but are most respectfully traversed in light of the following comments.

Applicants wish to direct the Examiner's attention to the basic requirements of a prima facie case of obviousness as set forth in the MPEP § 2143. This section states

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that to establish a prima facie case of obviousness, three basic criteria first must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine the reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations.

The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure. In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Section 2143.03 states that all claim limitations must be taught or suggested by the prior art. In re Royka, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). "All words in a claim must be considered in judging the patentability of that claim against the prior art." In re Wilson, 424 F.2d 1382, 1385, 165 USPQ 494, 496 (CCPA 1970). If an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. In re Fine, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988).

Applicants also note MPEP §2143.01, which states in part that, if a proposed modification would render the prior art invention unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. In re Gordon, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984).

Applicants also most respectfully direct the Examiner's attention to MPEP § 707.07(f) wherein it is stated that "[w]here the applicant traverses any rejection, the examiner should, if he or she repeats the rejection, take note of the applicant's argument and answer the substance of it."

The rejections of claims 3 and 7 each rely on the faulty assertion that Mis discloses each and every element of amended claim 1. Furthermore, Applicants respectfully submit that the Michael reference fails to remedy the deficiencies identified above with respect to the rejection of claim 1 over Mis alone. That is to say, Michael fails to disclose the second barrier layer comprising unreacted tin and copper that Mis fails to disclose. Accordingly, since neither Mis nor Michael, either standing alone or when taken in combination, disclose or suggest every element of claim 1, Applicants

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respectfully submit that claim 1 and all claims depending therefrom are patentable over the references cited.

Because the Official Action has failed to establish a proper §103 rejection of claims 3 and 7 according to the guidelines set forth in MPEP §2143, Applicants respectfully request that the §103 rejections of these claims be withdrawn.

In view of the above comments and further amendments to the claims, favorable reconsideration and allowance of all of the claims now present in the application are most respectfully requested.

Respectfully submitted,
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